

One major precaution must be taken in the use of the colour-control card. The dyes used in the card will probably themselves fade in bright light and in time. However, unlike biological records, these cards can be replaced. The user should merely protect his card as far as possible and compare it at intervals with a fresh card to ensure that the colours have remained unaltered.

AUTHOR'S NOTE

Naturalists may encounter some difficulty in obtaining supplies of paper of the correct colours. Kodak Ltd. of London, manufacture sets of colour separation guides which contain a strip of "colour patches" which include the three colours cyan, magenta and yellow. Unfortunately, six other coloured squares are included in the patches and for the purposes outlined in the paper the strip is unnecessarily bulky. Further, the colour separation guides include register marks and a grey scale which makes the set unnecessarily expensive. However, it appears that the separation guide remains the most satisfactory source of standard coloured squares for use in the technique I have described.

ACKNOWLEDGMENTS

The author wishes to acknowledge his indebtedness to Mr. E. Parlato of Kodak's Perth Office, for discussing the matter of colour control, obtaining the coloured materials which were used in the card described in this paper and critically reading the manuscript.

REFERENCES

- EVANS, R. M., W. T. HANSON, JR., and W. L. BREWER. 1953. *Principles of Color Photography*. John Wiley & Sons, New York, 709 pp.
- KODAK. 1950. Color as seen and photographed. *Kodak Color Handbook*. Eastman Kodak Co., Rochester, New York, 68 pp.

ANNOTATED FLORA OF ROTTNEST ISLAND, WESTERN AUSTRALIA

By G. M. STORR, Zoology Department, University of Western Australia.

Since February 1955 the writer has been working on various aspects of nutrition in the Quokkas (*Setonix brachyurus*) of Rottneest Island. A large part of the field work in the first two years was spent in examining the vegetation for evidence of Quokka grazing. Field-notes were transferred to cards, including one for each plant species, on which were recorded the date and locality of observations, the intensity of grazing and the growth stage of the plant. Although these data were gathered primarily for an understanding of the Quokka's economy, they also provide a basis for a flora of Rottneest.

In the following systematic list, brief notes have been extracted from the cards concerning the habit, distribution, abundance, palatability, etc., of each species. Exotic species are prefixed with an asterisk.

For the location of place names the reader is referred to the map in the *Journal of the Royal Society of Western Australia*, 42 (3), 1959.

CUPRESSACEAE

Callitris preissii Miq. The Rottneest Pine is now rare and confined to the far eastern end of the island. Around the Settlement all the trees are hedged and despite its toughness the bark is often removed by Quokkas from stems and exposed roots.

POTAMOGETONACEAE

This family of water plants is represented on Rottneest by five species. *Zostera muelleri* Irmisch, *Cymodocea antarctica* (Labill.) Endl., and *Posidonia australis* Hook f. are marine species that are frequently east ashore. *Lepilaena preissii* (Lehm.) F.v.M. and *Ruppia maritima* L. occur in brackish inland waters. None of these plants are eaten by the Quokka.

SCHEUCHZERIACEAE

Triglochin mucronata R. Br. A small winter annual. Occurs commonly in the damp soils around swamps and salt lakes. Heavily grazed in winter and spring.

T. trichophora Nees and *T. centrocarpa* Hook var. *brevicarpa*. Small winter annuals. Widespread in drier situations than the preceding species. Grazed in winter and early spring.

Cyanogeton procerum (R. Br.) Buchen. An aquatic plant; found on Rottneest only in Salmon Swamp. Not eaten.

HYDROCHARITACEAE

**Elodea canadensis* Mieh. Only found in the fresh-water soak at the north-eastern end of the airstrip. Not eaten.

GRAMINEAE

The various grasses constitute a major source of food for Quokkas. Only a few of the species are indigenous. Most of the introduced grasses are winter annuals that flourish in disturbed areas, especially roadsides.

**Pennisetum clandestinum* Hoehst. There is a dense sward of Kikuyu Grass between Garden Lake and the Settlement. During the winter it dies back. Fresh leaves appear in September and provide the Quokkas with good grazing throughout the summer.

**Stenotaphrum secundatum* (Walt.) Kuntze. Buffalo Grass is restricted to the eastern part of the island, especially round the Settlement, where it is heavily grazed.

Sphindax longifolius R. Br. A coarse, erect perennial. Common along sandy coasts. Only young plants are eaten.

S. hirsutus Labill. A coarse, flaccid perennial. Occurs on beaches and fore-dunes, but rare on Rottneest. Not eaten.

**Ehrharta longiflora* Sm. Annual Veld-grass. Grows to a height of two to three feet where inaccessible to Quokkas; otherwise grazed to the ground during winter and early spring.

**E. brevifolia* Sehrad. var. *enspidata* Nees. A relatively rare winter annual.

Stipa variabilis Hughes. A perennial tussock grass, the leaves narrow and inrolled, becoming wider and flatter in damp and sheltered situations. The dominant grass over most of the island. In spite of its abundance, this species is not ordinarily very important as food for Quokkas. They eat it only when it is young or kept green and short by continuous grazing. However, in burnt areas, because of its rapid regeneration, it becomes the principal food of Quokkas. And generally during the summer months it may locally be the only herbaceous plant available to the animals.

Sporobolus virginicus (L.) Kunth. A couch-like perennial. Occurs in mats around swamps and on seepage flats around salt lakes, and (rarely) on rock platforms beside the sea. During winter the mats may be under water, fresh or salt; as the water recedes with the advance of summer the grass renews its growth. Except where fenced off from Quokkas, it is grazed to the ground. A very important summer food plant in the swamp and lake areas.

**Polypogon monspeliensis* (L.) Desf. An erect annual, germinating in April and flowering in November. Plentiful in and around fresh-water swamps and in the seepage zone surrounding salt lakes. Heavily grazed.

**P. maritimus* Willd. A smaller and less plentiful species than the preceding. Occurs in much the same places and is likewise heavily grazed throughout the cooler part of the year.

**Lagurus ovatus* L. An erect annual, flowering in August and dying towards the end of October, except where persistent grazing has prevented flowering, in which case the plants remain green till the end of November. Widespread and plentiful in disturbed areas. Heavily grazed.

**Aira caryophylla* L. A small winter annual. Uncommon and restricted to the vicinity of salt lakes.

**Avena fatua* L. Wild Oats. An erect annual, germinating in April-May, flowering in August-September, and dying in October. Widespread but seldom plentiful. Heavily grazed.

Danthonia caespitosa Gaud. A tussock grass, smaller and much less plentiful than *Stipa variabilis* and *Poa caespitosa*; but like them it is only eaten when young or when kept low by persistent grazing.

**Koeleria phleoides* Pers. A winter annual. Flowers in August-September and dies in early November (except where continuously grazed). Widespread and plentiful. Moderately grazed.

**Briza minor* L. A small annual, flowering in August and dying in late October. Widespread and especially plentiful in the seepage zone around lakes and swamps, where it is grazed to the ground.

Poa caespitosa Forst. A tall tussock grass. Widespread and common, but, except near the coast, much less plentiful than *Stipa variabilis*, from which it is scarcely distinguishable in the vegetative stage. As with *Stipa*, old plants are never eaten.

**Poa annua* L. A winter annual. Uncommon outside of fenced areas, owing to intense grazing by Quokkas.

**Vulpia myuros* (L.) Gmel. An annual, flowering in August and dying in October. Widespread and plentiful. Moderately grazed.

**Desmazeria rigida* (L.). Tutin. A small winter annual. Widespread. Grazed.

**Bromus gussonii* Parl. An annual, germinating in April-May, flowering in September, and dying in October. Widespread in disturbed areas. Heavily grazed.

**B. rubens* L. An annual, flowering in September and dying in October. Common on roadsides. Moderately grazed.

**B. molliformis* Lloyd. An annual, flowering in September and dying in November. Common in disturbed areas, especially roadsides. Moderately grazed.

B. arenarius Labill. An annual, germinating in May, flowering in September, and dying in October. Widespread but uncommon where accessible to Quokkas. Heavily grazed.

**Brachypodium distachyon* (L.) Roem. et S. An annual, flowering in September, and dying in late October. Widespread, but not common, in disturbed areas. Heavily grazed.

**Cynodon dactylon* Pers. Couch. A creeping perennial. A common plant of the roadside and other disturbed situations in the far eastern end of the island. Usually grazed to the ground. An important food for the Quokkas in and around the Settlement, where it is often the only green herbaceous plant present in summer.

**Lolium rigidum* Gaud. Wimmera Rye-grass. A winter annual, flowering in September. Widespread but uncommon where accessible to Quokkas. Usually grazed to the ground.

**Parapholis incurva* (L.) Hubb. A small winter annual, flowering in September. Uncommon. Grazed.

**Hordium leporinum* Link. Barley-grass. An annual, flowering in August-September and dying in November. Widespread and plentiful. Heavily grazed.

CYPERACEAE

Scirpus nodosus Rottb. A tall sclerophyllous perennial sedge. Common in dense stands on the flats around salt lakes; also in coastal sand-dunes. Stems and leaves occasionally eaten in summer, especially in the vicinity of fresh-water seepages and soaks, where Quokkas become abnormally numerous in summer.

S. antarcticus L. A small relatively soft-leaved herb. Common and widespread. Heavily grazed, sometimes to extinction.

Lepidosperma gladiatum Labill. Sword-rush. A tall sclerophyllous perennial. Widespread, but only plentiful in hollows among coastal sand-dunes. This species was one of the first to regenerate after the big fires of February, 1955; fresh leaves grew rapidly from subterranean growing points. These leaves, especially their whitish underground portion, were often eaten in the desolated areas where no other forage was available. Otherwise the species is not touched.

L. resinosum (Nees) Benth. Similar to but much smaller than the preceding species. Occurs commonly on the stony ridges between Lighthouse Hill and the lakes. Most of this country was burnt in Feb-

ruary, 1955, and as this sedge was quick to regenerate, it became a major source of food for the great numbers of Quokkas living there. Heavily grazed throughout the year and exterminated in areas of high Quokka density.

L. angustatum R. Br. Similar in habit to *L. resinosum*. Uncommon and confined to a few stony ridges in the eastern third of the island. Lightly grazed in summer and autumn.

Gahnia trifida Labill. A coarse tussocky sedge with sharp-edged, highly fibrous leaves. Occurs on saline flats round the salt lakes. Usually only the inflorescence is eaten, but after fire fresh shoots from the charred bases of the plants are frequently eaten. Where the plants are tall and dense they provide the Quokkas with daytime shelter.

Carex preissii Nees. A small perennial grass-like sedge that dies back each summer, reshoots in late autumn and flowers in August. Widespread but only abundant in disturbed situations, e.g., recently burnt country. Highly palatable.

ARACEAE

**Zantedeschia aethiopica* (L.) Spreng. Arum Lily. A garden escape, established in a few damp localities. Usually uneaten, but occasionally leaves are nibbled. Contains poisons, including a skin-irritant (Hurst, 1942: 52-3).

RESTIONACEAE

Hypolaena sp. A slender erect perennial. Occurs on flats around the lakes, usually in association with *Scirpus nodosus*. Lightly grazed in summer.

CENTROLEPIDACEAE

Centrolepis polygyna (R. Br.) Hieron. A minute winter annual growing on the flats around Garden Lake.

JUNCACEAE

Juncus bufonius L. A small winter annual, flowering in September and dying in December. Occurs on the flats around salt lakes and elsewhere on shallow soil over limestone. Heavily grazed in the spring.

J. maritimus Lamk. A tall perennial rush. Occurs sparingly among *Scirpus nodosus* at Government House Lake.

LILIACEAE

Anguillaria dioica R. Br. A small winter annual. Occurs on stony ridges. Eaten sparingly.

Thysanotus patersonii R. Br. A perennial with twining stems. Uncommon.

Bulbine semibarbata (R. Br.) Haw. A small erect herb. Observed only on Forbes Hill in *Templetonia* scrub.

**Asphodelus fistulosus* L. Onion-weed. Widespread and abundant in disturbed situations. Usually only grazed when there is little other

forage. Young plants are eaten wholly, while in old plants only the central leaves are taken.

**Anthericum divaricatum* Jacq. A perennial herb, similar in habit to the preceding species. Seldom occurs away from coastal dunes. Occasionally eaten in summer.

Acanthocarpus preissii Lehm. A low, dense, spreading shrub with pungent leaves. Widespread and abundant. Seedlings are occasionally eaten. Less frequently browsed are the relatively soft tips of rapidly growing shoots of plants in the shade of taller shrubs. Dense stands of old plants serve as shelter for Quokkas.

AMARYLLIDACEAE

**Leucojum aestivum* L. A garden escape, established at Bathurst Point. Eaten only when young. Several of the cultivated members of this family have been proved poisonous.

**Agave americana* L. A garden escape, established in a few localities in the far eastern end of the island. The tough leaves are occasionally chewed by Quokkas.

Couostylis caudicans Endl. A perennial herb. Widespread and abundant in open country. Over most of the island this species is seldom eaten, but in areas of high Quokka concentration the plants may be grazed to the ground.

IRIDACEAE

**Homeria miniata* Sweet. Two-leaved Cape Tulip. Established near the hotel. Not eaten. Poisonous to cattle and probably to other livestock (Gardner and Bennetts, 1956).

**Ferraria undulata* L. Well established in the vicinity of Bathurst Point. Leaves are eaten only when young.

ORCHIDACEAE

Four species of orchid have been found on Rottneest; they are small winter annuals. Three of them are rare, viz., *Prasophyllum* sp., *Acianthus reniformis* (R. Br.) Schlechter, and *Eriochilus dilatatus* Lindl. The fourth, *Caladenia latifolia* R. Br., is moderately common in parts of the centre of the island; its leaves are occasionally eaten.

URTICACEAE

Parietaria debilis G. Forst. A flaccid winter annual, germinating in April. Widespread and abundant, especially in shady situations. Not eaten.

**Urtica urens* L. Nettle. An erect winter annual, germinating in April. Seedlings occasionally eaten.

CHENOPODIACEAE

Although this family provides many important fodder plants in Australia, several species under certain circumstances may become toxic. For example, various species of *Chenopodium* have been found to be cyanogenetic; others, including *Atriplex* and *Threlkeldia* spp. may accumulate high concentrations of oxalic acid (Gardner and Bennetts, 1956: 24-5).

Rhagodia baccata (Labill.) Moq. A dense succulent shrub, sometimes climbing over other shrubs and into trees. Moderately plentiful in coastal situations and in wooded parts of the interior of the island. Wherever there is a shortage of alternative food, due either to fire or abnormally high Quokka density, this plant is heavily browsed, the stems as well as leaves being eaten. Otherwise it may be only sparingly eaten.

***Chenopodium murale** L. An odoriferous annual. Rare.

Atriplex paludosa R. Br. A succulent shrub. Locally plentiful around the salt lakes; also occurs along the coast, especially in rocky situations. Occasionally eaten in summer.

A. cinerea Poir. A succulent shrub. Coastal, especially on fore-dunes. Seldom eaten.

Suaeda australis (R. Br.) Moq. A low succulent perennial. Occurs in the samphire zone around lakes and swamps. Heavily grazed in summer.

Euchylaena tomentosa R. Br. A spreading succulent shrub. Occurs only at Cape Vlaming and on Dyer's Island. Lightly browsed in summer at Cape Vlaming.

Threlkeldia diffusa R. Br. A low succulent perennial, sometimes climbing over larger shrubs. Common around the coast, lakes and swamps, especially under *Melaleuca*. Lightly grazed in summer; the bark is gnawed off the larger stems.

Arthrocnemum halocnemoides Nees. A succulent shrub, becoming large and woody with age. Plentiful round the salt lakes and brackish swamps. Young plants are heavily grazed in summer.

A. arbuscula (R. Br.) Moq. A low, rounded, twiggy, succulent shrub. Occurs around some of the lakes; much less plentiful than the other samphires. Never eaten.

Salicornia australis Banks et Sol. A low, ascending, succulent shrub. Usually associated with *Arthrocnemum halocnemoides*. Heavily grazed in summer.

AMARANTHACEAE

Hemichroa pentandra R. Br. A very small, usually prostrate, succulent shrub. Occurs in the samphire zone of salt lakes. Renews its growth as the water recedes in early summer.

AIZOCEAE

***Cryophytum crystallinum** (L.) N.E. Br. Ice-plant. A prostrate succulent annual, germinating in April, flowering in November and dying in December. Occurs only at the far western end of the island. Never eaten.

Carpobrotus aequilaterus (Haw.) N.E. Br. Pigface. A prostrate succulent perennial. Common on islets and staeks and at Cape Vlaming; sparingly distributed along the remainder of the coast; rare inland. Eaten in summer.

Tetragonia implexicoma (Moq.) Hook. f. A succulent perennial, prostrate or climbing over other shrubs. Occurs around the coast; rare inland. Eaten.

T. zeyheri. Fenzl. Similar to the preceding species, but more erect in habit and much rarer.

PORTULACACEAE

Portulaca oleracea L. A small prostrate succulent annual. The single plant seen was in an enclosure. Presumably eaten.

Calandrinia calyptrata Hook. f. A prostrate succulent winter annual, flowering in August-September. Widespread and moderately plentiful in sandy country. Eaten. Several species of *Calandrinia* have a high concentration of oxalic acid (Gardner and Bennetts, 1956: 27).

CAROPHYLLACEAE

Sagina apetala L. A very small winter annual, flowering in August-September. Widespread and plentiful. Eaten, though probably only incidentally, for it is a common constituent of the dense mat of annuals in disturbed areas.

Cerastium viscosum L. A small winter annual, flowering in August-September. Widespread and plentiful. Moderately grazed.

Stellaria media (L.) Vill. Chickweed. A small winter annual. Widespread and moderately plentiful. Heavily grazed where alternative forage is scarce (e.g., in burnt-out *Acacia* copses); otherwise grazed lightly or not at all.

**Areuaria serpyllifolia* L. A small winter annual. Uncommon.

**Polycarpon tetraphyllum* L. A small winter annual. Uncommon.

**Silene nocturna* L. A small winter annual. Uncommon. Eaten.

RANUNCULACEAE

Clematis microphylla DC. A woody climber. Plentiful in wooded parts of the island, especially in copses of *Acacia rostrilifera*. Seedlings and young plants are eaten, and the bark is stripped off older vines, especially in burnt country (bark was still being eaten in a burnt-out *Acacia* copse fourteen months after the big fire of February, 1955). The leaves of this and other species of *Clematis* contain a skin-irritant (Hurst, 1942: 114-5).

Ranunculus parviflorus L. A small winter annual. Only seen on Forbes Hill in *Templetonia* scrub. Sparingly eaten. Many species of *Ranunculus*, including the present one, are toxic (Hurst, 1942: 116-8).

CRUCIFERAE

**Sisymbrium orientale* L. A large annual, germinating in April and flowering in August; by November it is leafless. Only found in enclosures; presumably eaten out by Quokkas in most places.

**Diploxys muralis* (L.) DC. A large bushy herb where protected from Quokkas; otherwise small and prostrate. Occurs locally on roadsides and on bare ground. Heavily grazed.

Lepidium foliosum Desv. A small soft-leaved shrub. Observed only on Green and Dyer's Islands.

Heliophila pusilla L. A small winter annual. Rare.

Hymenolobus procumbens (L.) Nuttall. A small winter annual, flowering in August-September. Uncommon. Eaten.

**Coronopus didymus* (L.) Sm. A small prostrate winter annual. Observed only at Munt's Camp, where it was eaten.

Cakile maritima Scop. A plant of the beaches and fore-dunes. Uncommon. Not eaten.

RESEDACEAE

**Reseda luteola* L. A perennial herb. Rare. In summer the larger stems are barked and the cauline leaves stripped off; the fresh radical leaves appearing in April are sparingly eaten.

CRASSULACEAE

Crassula colorata (Nees) Ostenf. A very small succulent winter annual. Widespread and plentiful. Occasionally eaten.

C. macrantha (Hook f.) Diels et Pritzel. A very small winter annual. Widespread but less plentiful than *C. colorata*. Seldom eaten.

C. natans Thunb. An aquatic annual that continues to grow on mud after the water recedes. Never eaten.

PITTOSPORACEAE

Pittosporum phillyreoides DC. A shrub or small tree. Confined to shallow soil over limestone; occasionally on coastal cliffs; rare in western two-thirds of island. All accessible foliage is removed by Quokkas. Young plants are rare outside of exclosures.

LEGUMINOSAE

Acacia cyclopis A. Cunn. A small tree. Grows on shallow soil over limestone. Rare. Accessible foliage removed by Quokkas.

A. rostellifera Benth. A shrub or small tree. Widespread but becoming extinct over large areas of the island, particularly in the western two-thirds. Hardly a plant on the island has any accessible foliage; though it is the green bark of the smaller stems that is sought after, rather than the leaves. However, in burnt-out country the leaves of sucker shoots are heavily eropped.

A. eumcata A. Cunn. A dense prickly shrub. Occurs in coastal dunes. Seedlings are eaten and occasionally young shoots from old shrubs. The bark is frequently stripped off and eaten, the Quokkas often sitting in top of bushes to do so.

Templetonia retusa (Vent.) R. Br. An erect shrub. Confined to the eastern end of the island, where it grows in dense thickets on limestone ridges. All older shrubs seem to be hedged, and some of them carry old barking scars. However, north of the Salt Works there are several young bushy shrubs up to three feet high; none of these have been browsed. The animals, however, continue to eat seedlings and they occasionally bark shrubs in the summer.

**Trifolium tomentosum* L. and *T. suffocatum* L. Winter annuals, occurring at the Settlement. Grazed.

**Melilotus indica* (L.) All. King Island Melilot. An annual, germinating in April, flowering in August-September, and dying in November. Widespread and plentiful. Heavily grazed. Several workers (quoted by Hurst, 1942: 180) have found that paralysis in livestock has been caused by eating large amounts of *Melilotus*.

**Medicago denticulata* Willd. Burr Medic. An annual, germinating in April and flowering in August-September. Not so plentiful as

Melilotus. Heavily grazed. "Trefoil dermatitis," a kind of photo-sensitization, has been diagnosed in livestock that have eaten this plant (Gardner and Bennetts, 1956: 108).

GERANIACEAE

**Geranium molle* L. A small winter annual. Rare.

**Erodium cicutarium* (L.) L'Her. An erect winter annual. Plentiful on Green Island, but rare on the mainland of Rottneest.

Pelargonium australe Willd. A perennial herb, dying back in November-December; new shoots appear in March and seedlings in April-May. Widespread and abundant. Heavily grazed. In exclosures plants become quite bushy; but where exposed to Quokka grazing they remain small and prostrate, and may be locally exterminated.

OXALIDACEAE

Oxalis corniculata L. A small annual, germinating in April-May and flowering in August-September. Restricted to stony ridges.

ZYGOPHYLLACEAE

Nitraria schoberi L. A dense spreading shrub with succulent leaves, growing in pure stands in rocky coastal situations. Confined on Rottneest to the far western end of island and to offshore staeks and islets. Stems are barked by Quokkas.

Zygophyllum apiculatum F.v.M. A prostrate, succulent annual, germinating in May, flowering in August and dying in October. Occurs in sandy country, most frequently in coastal dunes. Eaten. Probably poisonous (Webb, 1948: 172).

RUTACEAE

Boronia alata Sm. A rigid shrub, the leaves relatively soft but strongly odoriferous. Confined to a few sites on the south east. Stems barked and foliage hedged.

Diplocaena dampieri Desf. A rigid woody shrub. Patchily distributed along the coast in dune scrub. Stems are frequently barked, the animals often sitting on top of shrubs when doing so. The foliage is less frequently eaten. Seedlings and young plants are rare outside of exclosures.

POLYGALACEAE

Comesperma sp. A perennial twiner. Uncommon.

EUPHORBIACEAE

Most of the species in this family are believed to be poisonous.

**Euphorbia peplus* L. An annual, germinating in March-April, flowering in August-September and dying in November. Widespread and abundant in disturbed situations. One of the first of the annuals to appear in autumn, it is heavily grazed during that season in areas of high Quokka concentration or in localities with little alternative forage; during winter and spring it is seldom eaten. "The genus produces a substance which causes irritation of the mucous membranes and skin . . ." (Hurst, 1942: 233).

Phyllanthus calycinus Labill. A small soft-leaved shrub. Moderately plentiful on limestone ridges, especially in the eastern half of the island. Lightly browsed in summer. Several species of *Phyllanthus* have been found poisonous to livestock (Hurst, 1942: 239-42).

Poranthera microphylla Brongn. A small annual, flowering in August-September and dying in November. Moderately plentiful on sandy soil in disturbed situations (e.g., in burnt country). Eaten. This species is cyanogenetic (Hurst, 1942: 242).

SAPINDACEAE

Dodonaea aptera Miq. A woody shrub. The only specimen seen was growing beside the main West End road a little east of the Narrow-Neck. It carried old barking scars.

RHAMNACEAE

Spyridium globulosum (Labill.) Benth. A tall shrub. A minor constituent of the limestone ridge scrub. Most plants are hedged, and in coastal situations where the shrubs are lower and denser Quokkas frequently climb on top of them to eat the foliage.

MALVACEAE

Lavatera plebeja Sims. A shrub. Not seen on the mainland of Rottnest; common on the islets.

***Malva parviflora** L. An annual, occurs on Green Island and sparingly round the Settlement. Responsible for staggers in sheep (Hurst, 1942: 270).

STERCULIACEAE

Guichenotia ledifolia J. Gay. A dense spreading shrub. Wide-spread and plentiful, especially in open country. Quick to regenerate after fire and generally tolerant of disturbance. Foliage rarely eaten, though leaves are often stripped off. Stems frequently barked where other forage is scarce.

Thomasia cognata Steud. A small shrub. A pioneer plant in burnt or otherwise vegetated country. Foliage very rarely eaten; stems barked occasionally in summer.

FRANKENIACEAE

Frankenia pauciflora DC. A small twiggy shrub with small leaves. Occurs in rocky situations on the coast. Seldom eaten.

MYRTACEAE

Melaleuca pubescens Schau. A tree or shrub. Confined to the eastern half of the island where the soil is shallow over limestone. On low-lying flats it occurs as a tree; in higher and sandier situations it becomes shrubby. In areas of high Quokka density all accessible foliage is eaten; elsewhere the plant is seldom touched.

UMBELLIFERAE

Hydrocotyle tetragonocarpa Bunge. A small prostrate winter annual. Widespread and plentiful. Occasionally eaten.

H. hispidula Bunge. A small winter annual. Uncommon. Eaten.

H. diantha DC. A small prostrate winter annual. Occurs in damp soil around lakes and swamps. Eaten. Various species of *Hydrocotyle* are suspected of being poisonous (Hurst, 1942: 307-8).

Didiscus pusillus (DC) F.v.M. A winter annual. Uncommon. Probably eaten. Suspected of being poisonous to sheep and cattle (Hurst, 1942: 306-7).

D. caeruleus DC. Rottnest Daisy. An erect, gregarious annual, germinating in April, flowering in November, and dying in December-January. Widespread, but patchily distributed, in open country. Seedlings and young plants are occasionally eaten.

Daucus glochidiatus (Labill.) Fisch., May. et Ave-Lall. A small winter annual. Widespread; most frequent in coastal dunes. Heavily grazed.

Apium australe Pet.-Thou. A small winter annual, plentiful on coastal cliffs; occasional on flats around salt lakes. Grazed.

EPACRIDACEAE

Leucopogon parviflorus (Andr.) Lindl. A dense rigid shrub. Occurs sparingly along the coast. Stems occasionally barked.

L. tusularis R. Br. A low, very dense and rigid shrub with small pungent leaves. Rare.

Acrotriche cordata (Labill.) R. Br. A low rigid shrub with small stiff leaves. Restricted to a few coastal localities, usually rocky.

PRIMULACEAE

***Aragallis feutua** Mill. Blue Pimpernel. A flaccid annual, germinating in April-July, flowering in August-September. Widespread and moderately plentiful in shady situations. Occasionally eaten. This species and the closely related *A. arvensis* are poisonous (Hurst, 1942: 311-2).

Samolus repens (Forst.) Pers. A creeping perennial herb. Plentiful on the damp flats around salt lakes. Heavily grazed in summer.

LOGANIACEAE

Mitrasacme paradoxa R. Br. A small winter annual. Uncommon. Eaten.

GENTIANACEAE

***Erythraea centaureum** Pers. An annual, germinating in August, flowering in November-March, dying in April. Widespread but most frequent in damp situations. Mostly eaten only when other herbaceous plants are scarce.

APOCYNACEAE

Alyxia buxifolia R. Br. A tall shrub. A minor component of the limestone ridge scrub. Accessible foliage is hedged and stems are barked in summer.

ASCLEPIADACEAE

***Asclepias fruticosa** L. Cotton-bush. Established in a few damp places in the eastern end of the island, especially on the flats north of Garden Lake, where it grows in sufficiently dense stands to pro-

vide the Quokkas with good cover. Never eaten. Poisonous (Webb, 1948: 22).

CONVOLVULACEAE

Wilsonia humilis R. Br. A prostrate perennial herb. Common in the samphire zone around salt lakes, appearing as the water recedes in early summer. Rarer along rocky coasts. Not eaten.

Dichondra repens R. and G. Forst. Small, perennial, stoloniferous herb. Widespread but uncommon. Not eaten.

BORAGINACEAE

Myosotis australis R. Br. An ascending annual, flowering in August-September and dying in October. Uncommon. Seldom eaten.

LABIATAE

Westringia dampieri R. Br. A dense rigid shrub. A common member of the dune scrub; less frequently an undershrub in the limestone-ridge scrub. Occasionally barked.

SOLANACEAE

Many plants in this family produce highly poisonous alkaloids.

Solanum simile F.v.M. An erect soft-leaved shrub. A pioneer plant on bare soil. The leaves, young stems, and bark of older stems are only eaten in areas where little or no other herbage is available. The ripe fruits are eaten in summer and autumn. Ordinarily the plant is not important as food; it is more valuable as shelter when growing in dense thickets in burnt-out country.

***Lycium ferocissimum** Miers. Boxthorn. A large, spreading, intricately-branched, thorny shrub with succulent leaves. A few occur round the Settlement. Leaves and bark are eaten, the Quokkas climbing up as high as eight feet into old shrubs to reach fresh shoots in the spring.

***Nicotiana glauca** Grah. Wild Tobacco. An erect, soft-leaved shrub. There is a small stand north of the Settlement. Not eaten. Poisonous to stock, but seldom eaten by them (Hurst, 1942: 364-6).

SCROPHULARIACEAE

***Dischisma arenarium** E. Mey. An ascending annual, flowering in August and dying in November. Widespread and plentiful in sandy country. Eaten.

***Parentucellia latifolia** (L.) Caruel. A small winter annual. Rare. Probably eaten.

OROBANCHACEAE

Orobanche australiana F.v.M. An erect herb, parasitic on the roots of other plants. Rare.

MYOPORACEAE

Myoporum viscosum R. Br. A small shrub. Patchily distributed on shallow soil over limestone, usually near swamps and lakes. Frequently browsed in summer and winter.

M. insulare R. Br. A thick-leaved shrub, tree-like in sheltered

situations. Patchily distributed around the coast. Often barked; the foliage is less frequently eaten.

Eremophila glabra (R. Br.) Ostenf. A shrub, usually small and slightly flaccid. Plentiful around the coast in rocky situations; rare inland. Where Quokkas are numerous it is heavily browsed, the bark being frequently stripped off; the leaves are less often eaten.

PLANTAGINACEAE

Plantago varia R. Br. A small perennial herb with radicle leaves. Widespread and moderately plentiful. Grazed, heavily so after the winter annuals have died.

RUBIACEAE

***Galium murale** (L.) All. A very small winter annual, dying in October. Widespread and plentiful. Eaten, perhaps only incidentally along with the other annuals that comprise the grazed mats in winter and spring.

GOODENIACEAE

Scaevola crassifolia Labill. A low spreading shrub with thick, sticky leaves. Abundant around the coast, especially on sand (on the foredune and as a pioneer on bare sand further inland). Young shoots are eaten and older stems are barked. A very important food-plant for Quokkas living near the sea, especially in the summer months, when there is little other palatable forage.

COMPOSITAE

***Erigeron canadensis** L. An erect annual or perennial herb, flowering at the end of summer, and resprouting in May, at which time seedlings appear. Seldom seen outside of exclosures and presumably grazed heavily. The sap contains a skin-irritant (Hurst, 1942: 408).

Olearia axillaris (DC) F.v.M. A dense greyish shrub with small aromatic leaves. The dominant plant of coastal sand-dunes; less plentiful inland. In areas where Quokkas are numerous all shrubs are hedged and barked, and young plants are eaten out. But in most localities where the species is common, Quokka densities are low and the plant is not often eaten.

Cofula coronopifolia L. An ascending, succulent, perennial herb. Only found at Barker's Swamp, where it grows in the damp black soil above high water level. Unless protected by shrubby samphires, the plants are grazed down to the ground.

C. australis (Less.) Hook f. A small winter annual. Only seen at the Settlement, where it is an infrequent member of the grazed mat of winter annuals.

Senecio laetus Soland. An erect succulent herb, annual or perennial. Dies back in the summer and resprouts in March-April; seedlings appear in May. Widespread and especially abundant in burnt or otherwise devegetated sandy country. Very seldom eaten.

***Arctotheca uvea** (L.) Levyns. A plant of coastal beaches. Rare on Rottnest.

***A. calendula** (L.) Levyns. Capeweed. A winter annual. Locally common on roadsides. Occasionally eaten early in the season.

Podosperma angustifolium Labill. An ascending annual, flowering in September, dying in October. Widespread but only moderately plentiful in burnt-out sandy country. Eaten.

Millotia tenuifolia Cass. An annual, flowering in September and dying in October. Locally plentiful in open sandy country. Eaten.

****Inula graveolens*** Desf. Stinkwort. An erect, aromatic, sticky annual; germinates in September, flowers in April, dies in June. Abundant on roadsides and in other disturbed situations, especially in low-lying areas. Seedlings and young plants may be grazed heavily in summer; old plants are infrequently browsed. Contact with the plant may give rise to dermatitis in man and other mammals (Gardner and Bennetts, 1956: 194).

Calocephalus brownii (Cass) F.v.M. A whitish shrub with very small leaves. Restricted to a few coastal localities, usually sandy. Not eaten.

****Carduus tenuiflorus*** Curtis. An annual thistle. Rare. Eaten.

****Centaurea melitensis*** L. A small annual, flowering in September, dying in December. Only seen in the immediate vicinity of Munt's Camp, where it is plentiful and heavily grazed.

****Hypochoeris glabra*** L. An annual with radical leaves; flowers in September-October, dies in November-December. Uncommon. Eaten.

****Sonchus oleraceus*** L. Sow-thistle. An erect annual with milky sap; germinates in April-July, flowers in August-September, dies in November-December. Heavily grazed.

DISCUSSION

Surprise is sometimes expressed that such typically south-western genera as *Eucalyptus* and *Banksia* do not occur naturally on the island, whereas other genera are present (*Pittosporum*, *Eremophila*, *Atriplex*, etc.) which are absent from the greater part of the South-western Land Division but reappear in the arid interior of the State. Both phenomena stem from the one fact that Rottneest is an island and too exposed to support anything but essentially coastal vegetation. It so happens in this latitude that representatives of *Eucalyptus* and *Banksia* are generally absent from the coastal vegetation, whereas Eremaean elements are conspicuous in it. There are few if any plants on Rottneest that do not also occur on the nearby mainland coast. And the few species which are not found on Rottneest and could reasonably have been expected there (e.g., *Hemiandra pungens*) have possibly become extinct since the separation of Rottneest from the mainland. Certain dune species are disappearing even now, e.g., *Acacia eyelopsis*, of which the writer has only seen four specimens, each growing in a widely separate locality; and *Dodonaea aptera*, only one bush of which, to his knowledge, remains on the island.

Despite the extinction that is inevitable on an island, Rottneest still retains a rich flora, owing to its varied physiography (see Storr, Green and Churchill, 1959). In the above list 180 species are recorded, of which 117 are indigenous.

The expenses of the writer's field-work on Rottnest were borne by C.S.I.R.O. and University Research Grants. The writer is also grateful to Messrs. R. D. Royce (Government Botanist) and J. W. Green (formerly of the Government Herbarium) for identifying most of his specimens and for much information on Rottnest plants.

REFERENCES

- GARDNER, C. A., and H. W. BENNETTS, 1956. *The toxic plants of Western Australia*. Perth.
- HURST, EVELYN. 1942. *The poison plants of New South Wales*. Sydney.
- STORR, G. M., J. W. GREEN and D. M. CHURCHILL. 1959. The vegetation of Rottnest Island. *J. Roy. Soc. W. Aust.*, 42: 70-71.
- WEBB, L. J. 1948. Guide to the medicinal and poisonous plants of Queensland. *C.S.I.R. Bull.* 232. Melbourne.

BREEDING OF BIRDS IN THE LOWER WONGONG VALLEY

By P. SLATER, Derby.

A number of recent papers have dealt with the breeding periods of birds in various parts of Western Australia: Robinson (*W.A. Nat.*, 4: 149), Carnaby (*W.A. Nat.*, 4: 187), Sedgwick (*W.A. Nat.*, 5: 46), Marshall and Serventy (*Emu*, 57: 99), Slater (*W.A. Nat.*, 7:35) and Lindgren (*W.A. Nat.* 7: 169). The present paper reports the situation in the foothills of the Darling Range between Armadale and Byford, as recorded by the writer in 1959.

The study area extended along the Wongong Valley for about two miles into the hills and for about four miles on to the coastal plain, confined to the immediate vicinity of the Wongong Brook. A number of distinct habitats can be recognised:—

(A) In the Darling Range

- (1) Dense undergrowth immediately surrounding the brook. Typical birds: Red-eared Firetail, Spotted Scrub-Wren, New Holland Honeyeater, Red-winged Wren.
- (2) Wandoo, Marri and Jarrah forest on the slopes, underlain by a thick carpet of harsh xerophytes. Typical birds: Splendid Wren, Western Thornbill, Spinebill.

(B) On the coastal plain

- (1) Pasture. Typical birds: Banded Plover, Pipit, White-faced Heron.
- (2) *Melaleuca* and bottlebrush swamp. Typical birds: Grey Teal, Brown Thornbill.
- (3) Open Marri forest. Typical birds: Yellow-tailed Thornbill, Twenty-eight, Magpie.

Although the area was frequently visited through the year, no breeding was recorded until July 23, continuing into spring and early summer. There were no outstanding deviations from the climatic normal, and the season may be regarded as a typical one.